ANNUAL ADMINISTRATIVE REPORT (FY2002) AND WORK PLAN (FY2003) FOR THE CAPE COD NATIONAL SEASHORE PROTOTYPE INVENTORY AND MONITORING PROGRAM

PART OF THE NORTHEAST COASTAL AND BARRIER NETWORK AND THE ATLANTIC AND GULF COAST BIOGEOGRAPHIC REGION

FY2002-FY2003

Northeast Region Approval Signature:

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I. Overview and Objectives

Ecological Context

Cape Cod is a large glacial peninsula that extends 60 miles into the Atlantic Ocean from the coast of Massachusetts. CACO encompasses 44,600 acres of marine, estuarine, fresh water, and terrestrial ecosystems. Marine and estuarine ecosystems include barrier islands, beaches, spits, tidal flats, salt marshes, salt ponds, and soft-bottom benthos. Freshwater ecosystems include kettle ponds, vernal pools, sphagnum bogs, forested swamps, and dune slack wetlands. Terrestrial systems include pitch pine and scrub oak barrens, pitch pine forests, oak forests, heathlands, dunes, and grasslands. Many of these habitats are globally uncommon and the species that occupy them are correspondingly rare.

During the past three centuries Cape Cod ecosystems have been altered profoundly by human occupation. For example, construction of dikes and ditches in estuaries has changed natural tidal regimes resulting in water quality degradation and loss of native plant and animal species. Beach and dune stabilization efforts have interfered with natural processes shaping shorelines. Discharges from nonpoint sources of pollution such as landfills, septic systems, and golf courses have adversely affected surface and ground-water quality. Fire suppression has altered the distribution and volume of the heathland and pitch pine communities that predominated before European settlement. Some of the highest ozone levels in the northeast have been recorded at CACO. The park includes many municipal and private in-holdings and is surrounded by varying densities of residential and commercial development. Add the over 5 million visitors that come to CACO each year, and the significance of the challenges facing CACO managers becomes apparent.

Program Overview

In 1996, CACO was identified as a prototype park for long-term ecological monitoring within the Atlantic and Gulf Coast biogeographic region. As a prototype park and in partnership with U.S. Geological Survey (USGS), CACO was charged with developing and refining long-term monitoring protocols that could be of utility to other Atlantic and Gulf Coast parks, in addition to supporting management of Cape Cod's natural resources. With the advent of the network approach to inventory and monitoring, our mission expanded to include focused technical support to the Northeast and Coastal Barrier Network. Specifically, our role as a prototype park is to:

- develop and implement a long-term ecological monitoring program that is scientifically sound and relevant to management of park resources;
- test inventory and monitoring methods;
- develop long-term monitoring protocols relevant to CACO and to systems common among parks in the Network and the broader biogeographic region;
- conduct studies to refine monitoring questions and help interpret monitoring results; and
- share our experience and technical expertise with the Network and parks in the broader biogeographic region.

Development of the CACO long-term ecological monitoring program has been a collaborative effort primarily between USGS and NPS. USGS has provided the bulk of the funding for development of a conceptual framework for the program and for protocol development. CACO began receiving funding specifically for the long-term monitoring program in 1997. Over the past five years, this funding has been used to support continued collaboration with USGS on protocol development, to implement completed monitoring protocols, to initiate specific studies needed to develop monitoring approaches, to provide information and technical assistance to the Network and other parks in the broader biogeographic region, and to build the personnel and logistical capability needed long-term monitoring.

Objectives

Our program objectives are listed below. The ecosystem approach for organizing our monitoring objectives (objectives 1-6 below) is based on the *Conceptual Framework for the Development of Long-term Monitoring Protocols at Cape Cod National Seashore* (Roman and Barrett 1999) and its 2002 Update (Boland et al 2002). These documents also describe the conceptual models used to select specific monitoring components, provide justification for each monitoring project, enumerate the specific monitoring questions being addressed, and identify the parameters being measured. Objectives seven through nine address outreach and reporting, technical support to other monitoring programs, and program management.

Cape Cod Long-Term Ecological Monitoring Program Objectives:

1. Assess and monitor the health of estuarine and salt marsh ecosystems.
2. Assess and monitor the health of beach, spit, and barrier island ecosystems.
3. Assess and monitor the health of pond and freshwater wetland ecosystems.
4. Assess and monitor the health of coastal upland ecosystems.
5. Assess and monitor park-wide and multiple-system indicators of ecosystem health.
6. Integrate monitoring efforts and results across ecosystems.
7. Share information, report findings, and document program activities.
8. Provide focused technical assistance to the Northeast Coastal and Barrier Network, to networks and parks within the Atlantic and Gulf Coast biogeographic region, and to other entities with common monitoring objectives.
9. Develop and sustain appropriate resources and infrastructure to ensure program objectives can be met now and into the future.

II. Accomplishments (FY2002) and Scheduled Activities (FY2003)

Objective 1 - Assess and monitor the health of estuarine and salt marsh ecosystems. Much of the information generated by the tasks below will also contribute to the estuarine restoration goals in CACO's General Management Plan (GMP) (National Park Service 1998).

Task 1.1 - Monitor salt marsh sediment elevation response to sea level rise

FY2002 Accomplishments:

- Salt marsh accretion, erosion, and relative elevation were measured at established sites in three estuaries during the spring and fall.

Scheduled FY2003 Activities:

- Collect accretion, erosion, and relative elevation measurements at established sites during the spring.
- Write a formal protocol to document the salt marsh elevation monitoring procedures followed at CACO.

Task 1.2 - Map intertidal habitats with an emphasis on estuarine systems

FY2002 Accomplishments:

- Obligated $45,031 (fund source: CACO I&M) for mapping and field verification of intertidal habitats. These funds were obligated through an existing Regional Cooperative Agreement with the Environmental Data Center, University of Rhode Island. The principal investigators are Michael Bradley, Peter August, and Charles LaBash.

Scheduled FY2003 Activities:

- Provide technical assistance and logistical support for the intertidal mapping project.

Task 1.3 - Monitor salt marsh vegetation

FY2002 Accomplishments:

- Collected the third year of data characterizing the salt marsh plant community at Hatches Harbor (previous data collected in 1997 and 2000).
- Established plots and initiated salt marsh vegetation monitoring at East Harbor.

- Developed study plans, established plots, and collected initial data to monitor the response of the plant community (currently dominated by the invasive exotic *Phragmites australis*) to restoration of salt water inundation with and without prescribed burning at Moon Pond.

Scheduled FY2003 Activities:

- Continue salt marsh vegetation monitoring at East Harbor.
- Establish salt marsh vegetation monitoring sites and collect initial data at Nauset Marsh, West End Marsh, and The Gut (Wellfleet Bay).
- Continue implementation of the Moon Pond *Phragmites* study (contingent on approval from the Town of Truro for the work required to return salt water to the site).

Task 1.4 - Monitor estuarine benthos and nekton.

FY2002 Accomplishments:

- In partnership with NPS-CESU, prepared a scope of work and obligated funds for development of an estuarine benthos monitoring protocol. The NPS-CESU executed the Cooperative Agreement and obligated $70,000 (fund source: USGS-BRD) toward the project; CACO obligated $30,000 (fund source: CACO I&M). Candace Oviatt and Sheldon Pratt at the Graduate School of Oceanography, University of Rhode Island, are the principal investigators.

Scheduled FY2003 Activities:

- Provide technical and logistical support for the estuarine benthos protocol development project.
- Initiate implementation of the recently completed estuarine nekton monitoring protocol (Raposa and Roman 2001).

Task 1.5 - Monitor wildlife use of estuarine systems

FY2002 Accomplishments:

- Collaborated with Massachusetts Audubon's Wellfleet Bay Wildlife Sanctuary to monitor nesting terrapins (*Malaclemys terrapin terrapin*).

Scheduled FY2003 Activities:

- Continue to collaborate with Audubon on the nesting terrapin monitoring project.
- Initiate implementation of the Migrating Waterbird portion of the waterbird monitoring protocol (Erwin et al 2002) at five estuarine/barrier beach systems. This protocol is still in draft, but we expect it to become finalized in FY2003, and at this time have enough detail to begin implementation.

Objective 2 - Assess and monitor the health of beach, spit, and barrier island ecosystems.

Task 2.1 - Develop geomorphic shoreline change monitoring protocol. The accomplishments and planned activities noted for this task implement the long-term monitoring strategy under the Coastal Processes Goal in CACO's GMP.

FY2002 Accomplishments:

- Provided review and comment on a draft shoreline change monitoring protocol (Allen et al 2001). Unfortunately Jim Allen, the primary investigator, passed away this summer. In the wake of his loss, the Northeast Coastal and Barrier Network has stepped forward to finish development of this protocol for application throughout the Network.

Scheduled FY2003 Activities:

- Provide technical and logistical support to the Northeast Coastal and Barrier Network's effort to develop this protocol.

Task 2.2 - Monitor beach and barrier island nesting birds.

FY2002 Accomplishments:

- The Division of Natural Resource Management monitored the breeding population and productivity of piping plovers (*Charadrius melodus*) (FT) at CACO. This monitoring project was initiated in 1985, and is funded by CACO-NRM base funds.

- The Division of Natural Resource Management monitored breeding populations and nesting effort of colonial waterbirds.

Scheduled FY2003 Activities:

- Nesting populations and productivity of piping plovers and colonial waterbirds will continue to be monitored.

Objective 3 - Assess and monitor the health of pond and freshwater wetland ecosystems. All the tasks associated with this objective further the strategies described in CACO's GMP for protecting water quality, water quantity, and wetlands.

Task 3.1 - Map the freshwater aquatic systems in the park.

FY2002 Accomplishments:

- Added about 50 sites to the aquatic habitat data base and GIS-based map. All mapped sites are named, classified, and characterized.

Scheduled FY2003 Activities:

- Complete the freshwater aquatic habitat mapping project.

Task 3.2 - Characterize and develop monitoring protocol for dune slack wetlands.

FY2002 Accomplishments:

- Prepared a comprehensive work plan for a dune slack characterization study and protocol development (Smith and Portnoy 2002). This is a joint project with CACO's Division of Natural Resource Management funded by a $31,000 grant from WRD to CACO-NRM.
- Selected study sites (nine dune slacks), installed groundwater wells, and initiated hydrologic monitoring.

Scheduled FY2003 Activities:

- Continue implementation of the dune slack project as described in the comprehensive work plan.

Task 3.3 - Monitor kettle pond water quality and limnology.

FY2002 Accomplishments:

- Conducted annual water quality monitoring at all 20 CACO kettle ponds according to the kettle pond monitoring protocol (Portnoy et al 2001).
- Began revising the 2001 version of the protocol to incorporate minor corrections and update selected field and laboratory methods.

Scheduled FY2003 Activities:

- Complete revision of the protocol.
- Continue annual monitoring at all ponds according to the revised protocol.

Task 3.4 - Inventory and develop monitoring protocol for freshwater aquatic invertebrates.

FY2002 Accomplishments:

- Executed a Cooperative Agreement and obligated $51,000 (fund source: CACO I&M) for development of a freshwater aquatic invertebrate monitoring protocol. The principal investigators are David Foster and Elizabeth Colburn at Harvard University.

Scheduled FY2003 Activities:

- Collaborate on specific elements of the protocol development project, as called for in the proposal (Foster 2002) and Cooperative Agreement, and provide technical and logistical support as needed.

Task 3.5 - Inventory and develop monitoring protocol for freshwater fish.

FY2002 Accomplishments:

- Reviewed and commented on an inventory and draft monitoring protocol for freshwater fish at CACO and other northeast parks (Mather et al 2002).

Scheduled FY2003 Activities:

- Provide additional review and comment as necessary to produce a final monitoring protocol.

Task 3.6 - Monitor amphibians.
FY2002 Accomplishments:
- Carried out the USGS Northeast Amphibian Research and Monitoring Initiative (NARMI) at 17 of CACO's vernal ponds. This is a regional monitoring program that uses egg mass counts to monitor vernal pond breeding amphibians. Robin Jung, USGS-BRD, is the principal investigator for the regional project.
- Provided review and comment on the draft pond-breeding amphibian monitoring protocol (Paton et al 2002).
- Collected the second and final year of data for a study examining the use of coverboards for monitoring terrestrial salamanders.

Scheduled FY2003 Activities:
- Provide additional review and comment to finalize the pond-breeding amphibian monitoring protocol. The NARMI protocol will be integrated into the egg mass component of the final document.
- Initiate monitoring as called for by the pond-breeding amphibian protocol. Although the document has not been finalized, we have enough detail to begin implementation. We plan to implement the egg mass count component at 20 vernal ponds and the anuran call count component at 30 ponds.
- Analyze the coverboard data to assess the efficacy of this technique for monitoring terrestrial salamanders; prepare a report with recommendations regarding future monitoring.

Task 3.7 - Inventory aquatic turtles and assess the feasibility of long-term monitoring.
FY2002 Accomplishments:
- Collected the third and final year of aquatic turtle trapping data for a study assessing habitat associations, distribution, and the feasibility of conducting long-term monitoring of this group.

Scheduled FY2003 Activities:
- Analyze the turtle trapping data and draft a report that includes recommendations regarding future monitoring.
- Conduct an additional year of spotted turtle (*Clemmys guttata*) (SC) trapping at Pamet Bog and Red Maple Swamp. Additional data is needed to complete the systematic and quantitative inventory of this species at CACO.

Task 3.8 - Monitor freshwater marsh birds.
Scheduled FY2003 Activities:
- Initiate implementation of the Marsh Waterbird portion of the waterbird monitoring protocol (Erwin et al 2002) at seven freshwater sites. This protocol is still in draft, but we expect it to become finalized in FY2003, and at this time have enough detail to begin implementation.

Objective 4 - Assess and monitor the health of coastal upland ecosystems.
Task 4.1 - Improve understanding of Province Lands vegetation communities
FY2002 Accomplishments:
- Initiated characterization of the species composition of algal dune crusts and their influence on soil moisture.

Scheduled FY2003 Activities:
- Complete algal dune crust characterization and incorporate relevant findings into vegetation monitoring protocols.

Task 4.2 - Develop monitoring protocol for coastal heathlands. The accomplishments and planned activities noted for this task are also the first step toward developing the heathland management plan called for in CACO's GMP.

FY2002 Accomplishments:

- Completed data analysis phase of heathland protocol development study and began drafting protocol.

Scheduled FY2003 Activities:

- Complete draft monitoring protocol and distribute for peer review.

Task 4.3 - Develop monitoring protocol for coastal forests.

FY2002 Accomplishments:

- Based on evaluation of data collected in FY01, revised and augmented vegetation data collection methods and resurveyed existing sites.

Scheduled FY2003 Activities:

- Establish additional sites to include red maple, black locust, and Atlantic white cedar forest types.
- Incorporate leaf litter quality and decomposition rates into protocol.
- Complete a report documenting the status of protocol development and describing the work plan for completing the protocol.

Task 4.4 - Inventory reptiles and assess the feasibility of long-term monitoring.

FY2002 Accomplishments:

- Completed the second of two planned years of snake coverboard monitoring.
- Continued monitoring Eastern box turtles (*Terrapene carolina carolina*) through incidental encounters.

Scheduled FY2003 Activities:

- Complete analysis of snake coverboard data and draft a report describing the results and recommendations for continued monitoring.

Task 4.5 - Develop a long-term monitoring protocol for landbirds.

FY2002 Accomplishments:

- Provided logistical support and technical assistance to the principal investigator (Curtice Griffin, University of Massachusetts, Amherst) developing a long-term monitoring protocol using avian point counts. This was the second of three planned field seasons.
- Amended an existing Cooperative Agreement to provide $39,970 (fund source: CACO I&M) for the third field season, analysis, and report preparation. A report and draft protocol are expected in FY2004.
- Provided logistical support and technical assistance to the principal investigator (David DeSante, Institute for Bird Populations) testing the MAPS (Monitoring Avian Productivity and Survivorship) protocol at CACO. This was the fourth of five planned years of field testing.
- Amended an existing Cooperative Agreement to provide $27,000 (fund source: CACO I&M) for the fifth field season, analysis, and report preparation. A report is expected in FY 2004.

Scheduled FY2003 Activities:

- Provide logistical support, technical assistance, and document review for the avian point count and MAPS projects.

Task 4.6 - Assess the feasibility of long-term small mammal monitoring.

FY2002 Accomplishments:

- Analyzed the mark-recapture data collected in FY2000 and FY2001 using different techniques (CAPTURE, Lincoln-Peterson, and JOLLY) to evaluate the utility of each.

Scheduled FY2003 Activities:

- Complete a report assessing the utility of various mark-recapture techniques for small mammal monitoring, assess the feasibility of long-term small mammal monitoring at CACO, and provide recommendations regarding continued monitoring.

Task 4.7 - Assess the feasibility of long-term meso-mammal monitoring.
FY2002 Accomplishments:
- Provided logistical support and technical assistance to the principal investigator (Allan O'Connell, USGS Patuxent Wildlife Research Center) testing meso-mammal techniques at CACO, FIIS, GATE, and COLO. A draft report is expected in FY2003.

Scheduled FY2003 Activities:
- Provide logistical support, technical assistance, and document review for the meso-mammal monitoring effort.

Objective 5 - Assess and monitor park-wide and multiple-system indicators of ecosystem health.
Task 5.1 - Monitor meteorologic, atmospheric deposition, and air quality parameters. The accomplishments and planned activities noted under this task implemenst the research, monitoring, and effects detection strategies in CACO's GMP under the Air Resources Goal.
FY2002 Accomplishments:
- Continued monitoring precipitation, atmospheric deposition through NADP, aerosols through IMPROVE, and ozone in partnership with the State.

Scheduled FY2003 Activities:
- Continue precipitation, NADP, IMPROVE, and ozone monitoring.
- Initiate monitoring atmospheric deposition of mercury.
- Assess the feasibility of monitoring ozone damage using indicator plant species.

Task 5.2 - Monitor hydrology and ground water quality. This task is also contributes to the water quality and quantity protection strategies noted in CACO's GMP.
FY2002 Accomplishments:
- Secured archeological clearance and assisted USGS in the installation of new ground water monitoring wells.
- Continued monthly collection of ground water level and pond stage information.
- Reviewed and commented on the draft hydrology monitoring protocol (McCobb and Weiskel 2002). This document will be finalized in early FY2003.
- Executed an Inter-Agency Agreement and obligated $60,000 (fund source: CACO I&M) for development of a ground-water quality monitoring protocol. The principal investigators are John Colman and Peter Weiskel with the USGS Water Resources Discipline, MA-RI District.

Scheduled FY2003 Activities:
- Initiate implementation of the hydrology monitoring protocol.
- Provide review and comment on a draft ground-water quality monitoring protocol. We expect this document to be drafted and finalized during FY2003.

Task 5.3 - Complete vegetation map based on 2000 aerial photography. This map, together with the array of vegetation monitoring activities described under other objectives, are also part of the native plant and wildlife habitat restoration strategy described under the biotic resource management goal in CACO's GMP.
FY2002 Accomplishments:
- Amended an existing agreement to provide NatureServe with $44,643 (funded through the Northeast Coastal and Barrier Network) for finalization of the classification system, field sampling, data analysis, and preparation of the final map.
- Amended an existing agreement to provide the University of Massachusetts with $8,009 (fund source: CACO I&M) for completing interpretation and digitizing the 2000 aerial photography.
- Provided logistical support and technical assistance to NatureServe and the University of Massachusetts.

Scheduled FY2003 Activities:
- Continue to provide logistical and technical support to NatureServe and the University of Massachusetts as necessary to complete field work and digitize the aerial photos.

- Provide review and comment on draft products as necessary to finalize the vegetation map and accompanying report. We expect this product to be completed before the close of FY2003.

Task 5.4 - Laboratory analysis in support of plant community characterization.
Scheduled FY2003 Activities:
- Analyze plant samples from heathland, salt marsh, and other habitat types for carbon, nitrogen, sulfur, phosphorous, cations, and anions.

Task 5.5 - Develop long-term monitoring protocols for waterbirds.
FY2002 Accomplishments:
- Provided review and comment on the draft waterbird monitoring protocol (Erwin 2002). This document is really four distinct protocols focusing on separate groups of waterbirds: colonial waterbirds, most of which are associated with beach and barrier island systems; migrating waterbirds associated with estuarine systems; marsh birds associated with freshwater systems; and piping plovers which are tied to beach and barrier island systems. [Monitoring tasks associated with each group are reported under the appropriate ecosystem objective.]

Scheduled FY2003 Activities:
- Provide additional review and comment as necessary to finalize the protocol during FY2003.

Objective 6 - Integrate monitoring efforts and results across ecosystems.
Task 6.1 - Develop and integrated data management system.
FY2002 Accomplishments:
- Detailed Alan Williams (Data Manager, SHEN) to help assess our data management needs, provide technical assistance on data base construction, and initiate conversion of existing data. During Alan's detail, an ACCESS database was developed for herptofauna and improvements were made to an existing ACCESS forest vegetation data base.
- Began recruitment for a data manager at the GS-11 level with an ecology background and expertise in ACCESS database design.

Scheduled FY2003 Activities:
- Complete the hiring process for the data manager position.
- Complete an agreement with the Northeast Coastal and Barrier Network to share the data manager position (CACO will fund 75%, the Network will fund 25%).
- Produce a draft data management plan.

Task 6.2 - Develop an inter-disciplinary study area approach to promote understanding of the causes of change.
FY2002 Accomplishments:
- Developed the framework for an inter-disciplinary study area (ISA) approach and selected four prototype ISAs: the Eastham vernal pool complex and associated uplands, the Nauset Marsh watershed, the Wellfleet/Truro kettle pond chain area, and a representative portion of the Province Lands dunes landscape. This emerging concept is described in the 2002 Update to the Conceptual Framework (Boland et al 2002).

Scheduled FY2003 Activities:
- Present the ISA concept for discussion and feedback at the CACO LTEM Symposium scheduled for November, 2002, and continue development of the approach through FY2003.

Task 6.3 - Prioritize monitoring needs within and across ecosystems to ensure that our core monitoring program is sustainable for the long-term while meeting scientific objectives.
Scheduled FY2003 Activities:
- Begin planning for a series of workshops with staff and technical advisors to prioritize monitoring activities.

Objective 7 - Share information, report findings, and document program activities.

Task 7.1 - Share information with non-technical audiences.

FY2002 Accomplishments:

- Conducted training sessions for seasonal interpretive staff.
- Finalized format for "Seashore Science" fact sheets and produced two prototypes.
- Produced a "Frequently Asked Questions" supplement to the 2001 Kettle Pond Data Atlas (Portnoy 2001).
- Gave a presentation on aquatic turtle monitoring at the Cape Cod Natural History Symposium.

Scheduled FY2003 Activities:

- Continue to conduct training sessions for seasonal interpretive staff.
- Finalize "Seashore Science" development, production, and distribution arrangements with the Division of Interpretation and Cultural Resources. Produce at least two during FY2003.

Task 7.2 - Share technical information with scientists, NPS audiences, and other entities interested in monitoring and resource management.

FY2002 Accomplishments:

- Began editing and correcting the CACO vertebrate section of NPSpecies.
- Collaborated with CACO's Atlantic Learning Center to produce a research catalog describing research and monitoring needs that are unlikely to be fulfilled by existing programs (Thelan 2002). The Learning Center plans to post the research catalog on the web in FY2003.
- Began planning and preparation for a symposium on long-term ecological monitoring at CACO.
- Began preparation of an update to the 1999 Conceptual Framework for this program (Boland et al 2002).

Scheduled FY2003 Activities:

- Continue editing and updating the CACO entries in NPSpecies.
- Hold the symposium on CACO's long-term monitoring program on November 5 and 6, 2002. Confirmed participants include scientists from USGS and academia; NPS managers, scientists, and I&M staff; CACO managers and staff; State research and conservation agencies; municipal and county agencies; and non-governmental organizations.
- Finalize the Conceptual Framework update.
- Prepare and submit manuscripts to peer reviewed journals on the algal dune crust characterization study, heathland protocol development work, and analysis of the Hatches Harbor salt marsh vegetation data.
- Submit an abstract for presentation of a poster or paper on the heathland work at the next Conservation Biology, Ecological Society of America, or similar society's conference.

Task 7.3 - Document activities and findings.

FY2002 Accomplishments:

- Completed the annual administrative report for FY2001 and work plan for FY2002.

Scheduled FY2003 Activities:

- Complete the following protocols and reports in-house:
  - salt marsh sediment elevation monitoring protocol
  - draft heathland monitoring protocol
  - kettle pond water quality monitoring protocol revision
  - coastal forest protocol development report
  - reptile protocol development report
  - terrestrial salamander protocol development report
  - small mammal protocol assessment report

- Assist cooperators in finalizing the following protocols:
  - ground-water quality monitoring protocol
  - pond-breeding amphibian monitoring protocol
  - waterbird monitoring protocol

Objective 8 - Provide focused technical assistance to the Northeast Coastal and Barrier Network, to networks and parks within the Atlantic and Gulf Coast biogeographic region, and to other entities with common monitoring objectives.

Task 8.1 - Share technical expertise with the NC&B Network and other parks.

FY2002 Accomplishments:

- Provided technical leadership on a herptofaunal inventory project at ten NPS units in the Northeast Region. This project is funded by the Northeastern Region and is being conducted in partnership with the Wildlife Conservation Society. FY2002 activities included developing inventory sampling plans, hiring and training field crews, supervising initial field work, and reviewing reports.
- Provided technical leadership on the NC&B Network's contaminants baseline inventory and monitoring protocol development project. FY2002 activities included revising the scope of work, developing a conceptual model, and conducting the first park reconnaissance at CACO.
- Provided technical assistance to the Regional Office and parks through review of proposals and reports including: a proposal for an inventory of diamondback terrapins and freshwater turtles at ASIS; a proposal and workplan for mammal inventories at multiple parks; and reports on herptofaunal inventories at three parks.

Scheduled FY2003 Activities:

- Continue work on the herptofaunal inventory project.
- Continue work on the NC&B contaminants project.
- Provide technical assistance to the Regional Office and other parks as requested.

Task 8.1 - Provide technical assistance to other monitoring efforts.

FY2002 Accomplishments:

- Assisted the Cape Cod Commission, lower Cape towns, Wellfleet Shellfish Department, and Massachusetts Audubon's Wellfleet Bay Sanctuary with fresh and salt water quality monitoring. Assistance included training volunteers and performing the laboratory analyses for all samples. CACO's contribution to this project is supported by CACO's Division of Natural Resource Management, CACO I&M, and a grant from the Community Foundation of Cape Cod.

Scheduled FY2003 Activities:

- Continue support of local water quality monitoring projects by providing training and laboratory analysis services.

Objective 9 - Develop and sustain appropriate staff resources and laboratory infrastructure to ensure program objectives can be met now and into the future.

Task 9.1 - Build and replace technical expertise

FY2002 Accomplishments:

- Hired a plant ecologist.
- Hired an aquatic ecologist trainee (SCEP student).

Scheduled FY2003 Activities:

- Hire a data manager (also listed under Objective 6).
- Investigate cooperative agreement or other arrangement with USGS-WRD to provide technical assistance and mentoring to a hydrology technician.

Task 9.2 - Secure an adequate workforce to complete scheduled field and laboratory tasks.
FY2002 Accomplishments:

- Provided six months of salary for a laboratory technician. This is a four-year, subject to furlough term position shared with the Division of Natural Resource Management.
- Hired or continued support (from FY2001) for five seasonal bio-techs for the following projects:
  - data management assistance (SCEP student)
  - small mammal trapping
  - coastal forest vegetation monitoring
  - amphibian and reptile monitoring
  - pond water quality and hydrology monitoring.
- Recruited and supported four Student Conservation Association volunteers to assist the bio-techs on the projects listed above.

Scheduled FY2003 Activities:

- Hire a four-year term bio-tech for aquatic ecology monitoring projects.
- Hire a four-year term hydrology tech for physical science monitoring projects.
- Hire or continue support (from FY2002) for five seasonal bio-techs for the following projects:
  - coastal forest vegetation monitoring
  - salt marsh monitoring
  - nekton monitoring
  - amphibian and reptile monitoring
  - marsh and migratory waterbird monitoring.
- Recruit and support seven Student Conservation Association or other volunteers to assist the seasonal and term bio-techs on the projects listed above, and with the pond water quality monitoring project.

Task 9.3 - Improve program efficiency and coordination.
FY2002 Accomplishments:

- Began preparations and coordination for a Program Review.
- Began development of a five-year staffing plan.

Scheduled FY2003 Activities:

- Hold the Program Review on November 7 and 8, 2002, in conjunction with the symposium.
- Revise plans as appropriate based on feedback from the Program Review Panel.
- Complete the 5-year staffing plan.

Task 9.4 - Contribute to the development of the analytical laboratory.
The following scheduled activities will be directed by the Division of Natural Resource Management's Chemist with assistance from Prototype staff.
Scheduled FY2003 Activities:

- Initiate participation in the USGS Standard Reference Sample Project for quality assurance for nutrient and trace element analyses.
- Develop a Lab Quality Assurance Project Plan (QAPP) for State approval.
- Develop a Lab Handbook of Analytical Methods to centralize documentation of analysis procedures used in the lab.

III. Staffing

CACO Prototype Staff
Carrie Phillips, Prototype Coordinator
Chris Pearson, Budget Assistant
Robert Cook, Wildlife Ecologist
Stephen Smith, Plant Ecologist
Evan Gwilliam, Aquatic Ecologist
Kelly Boland, Wildlife BioTech
Data Manager - To Be Hired in FY2003
Aquatic Ecology BioTech - To Be Hired in FY2003\
Hydrology Tech - To Be Hired in FY2003

CACO Natural Resource Management Staff
Many critical program functions are also carried out by the Division of Natural Resource Management. The individuals listed below provide management oversight, GIS support, laboratory management, piping plover and colonial waterbird monitoring, and expertise in chemical analysis, biogeochemistry, and ecology.
Nancy Finley, Division Chief
John Portnoy, Ecologist
Mark Adams, GIS Specialist
Krista Lee, Chemist
Judith Oset, Laboratory Tech
Mary Hake, Plover and Colonial Waterbird BioTech
Meg Lamont, Natural Resource Specialist

Primary Science Advisor:
Charles Roman, Research Coordinator, NPS-CESU

Cooperators:
Don Cahoon, USGS-BRD, Patuxent Wildlife Research Center
Elizabeth Colburn, Harvard University, Harvard Forest
John Colman, USGS-WRD, MA-RI District
David DeSante, Institute for Bird Population
Mark Duffy, ASIS/Northeast Coastal and Barrier Network
Michael Erwin, USGS-BRD, Patuxent Wildlife Research Center
Howard Ginsberg, USGS-BRD, Patuxent Wildlife Research Center
Curtice Griffin, University of Massachusetts, Amherst
Mary-Jane James-Pirri, Graduate School of Oceanography, University of Rhode Island
Jeff Marion, Virginia Tech University
Martha Mather, University of Massachusetts, Amherst
Barbara Nowicki, Graduate School of Oceanography, University of Rhode Island
Allan O'Connell, USGS-BRD, Patuxent Wildlife Research Center
Candace Oviat, Graduate School of Oceanography, University of Rhode Island
Peter Paton, University of Rhode Island
Sheldon Pratt, Graduate School of Oceanography, University of Rhode Island
Kenneth Raposa, Graduate School of Oceanography, University of Rhode Island
Mark Robson, Rutgers University
Peter Weiskel, USGS-WRD, MA-RI District

In addition to those listed above, the efforts described in this report and work plan depend on the dedicated efforts of a dynamic cadre of seasonal technicians, research assistants, graduate students, undergraduate student interns, and volunteers.

IV. Public Interest Highlights

- Research conducted to support development of an amphibian monitoring protocol found that Cape Cod National Seashore supports the most significant population of eastern spadefoot toads (*Scaphiopus holbrooki holbrooki*) in Massachusetts and possibly in the entire Northeastern United States. This State-listed species is an irruptive breeder, emerging from underground burrows to breed on warm, rainy summer nights. The spadefoot evolved from desert ancestors adapted to breed in short-lived shallow ponds. While they occur throughout the Seashore, the largest concentration of this species is found in the Province Lands area where there is a high density of vernal ponds and dune slack wetlands. Once emerged from their burrows, spadefoots travel across the landscape in search of suitable ephemeral breeding habitat. Unfortunately, many individuals are killed by vehicles when their post-emergence dispersal takes them across roads. Field crews conducting road surveys found up to fifty percent mortality of spadefoots along the two main roads through the Province Lands area. The Seashore is considering management options to reduce the incidence of spadefoot road-kill.

- As part of an effort to design vegetation monitoring protocols, the program's Plant Ecologist began investigating the algal crust found on the Seashore's extensive dunes. The filamentous green alga that form the surficial dune crust are able to tolerate long periods of desiccation and seem to come alive when sufficient dew or rainfall allows for bursts of productivity. These crusts appear to act as a glue that prevents sand from being carried away by wind and rain, and as a cap that reduces the evaporation of interstitial water. Physical disturbance destroys the structural integrity of algal crusts and their soil stabilization and water retention properties. The Seashore hopes to study these crusts in more detail to better understand their ecological significance and determine if protective management is needed.

- Under the leadership of CACO's Atlantic Learning Center, the monitoring program assisted in the development of a catalog describing research and monitoring needs that are unlikely to be fulfilled through existing Natural Resource and I&M programs (Thelan 2002). This catalog will be made available to researchers interested in working on the Cape in partnership with the Learning Center. The Learning Center plans to post the research catalog on the web in FY2003 and update it on a regular basis.

V. Reports, Publications and Presentations

<u>Reports and Publications</u>:

DeSante, D. F. 2001. The Monitoring Avian Productivity and Survivorship (MAPS) Program at Cape Cod National Seashore. 24pp plus Appendices. CACO Files.

Erwin, R. M., C. J. Conway, and S.W. Hadden. 2002 Species occurrence of marsh birds at Cape Cod National Seashore, Massachusetts. Northeastern Naturalist 9(1): 1-12.

Portnoy, J.W, M.G. Winkler, P.R. Sanford, C.N. Farris. 2001. Kettle Pond Data Atlas Supplement: Frequently Asked Questions and Glossary of Terms About Paleoecology and Modern Water Quality. Cape Cod National Seashore, National Park Service, U.S. Department of Interior. 21 pp.

Presentations:

Aquatic Turtle Inventory at Cape Cod National Seashore. Cape Cod Natural History Conference, March 2002.

VI. Status of Park Vital Signs Monitoring

Cape Cod National Seashore	Air Quality	Water Quality	Water Quantity	Geologic Resources	Plants	Animals	Landscape Characteristics
Planning and Design							
w/NRC funding		1		1	5	5	
w/other funding		1			2	5*	
Protocols Implemented							
w/NRC funding		1	1	1	1	3	
w/other funding	1					2	
Analysis/Synthesis Avail.							
w/NRC funding		1				1	
w/other funding	1					2	

* One of these projects (estuarine benthos) is funded by USGS-BRD ($70,000) and NRC ($30,000).

VII. Budget

In FY2002, the Cape Cod Prototype Program received $702,000 in Inventory and Monitoring Funds. This amount represents the permanent addition of $189,000 to the $513,000 of I&M Funds that previously comprised our base funding. Nearly half of these funds were obligated to cooperative agreements for priority mapping and protocol development projects. Staff salaries and support for seasonal technicians and volunteers accounted for another 43 percent. Our operations and equipment expenses included one-time purchases of analytical equipment for the laboratory and a vehicle. The remainder was used to support field operations (every thing from Aluminum tags to Ziploc bags), laboratory analysis (reagents and other consumable lab supplies), computer capabilities (work stations, software license renewals, printer supplies, etc), GPS equipment, and other miscellaneous expenses.

We anticipate an authorization of $702,000 again in FY2003. We estimate that over 75 percent of our budget will be dedicated to staff salaries and support for seasonal technicians and volunteers. This increase, up from 43 percent in FY2002, will result from completion of our core staff with the addition of a Data Manager and two four-year term technicians, and an increase in field staff as we begin to implement completed protocols. We expect that some of our ongoing projects will produce information or additional questions that warrant further investigation. As a result, we have set aside eleven percent of our budget for new cooperative agreements or to augment existing agreements. At this time, we do not anticipate making any large, one-time purchases of lab equipment or vehicles; however, in anticipation of an increase in lab analyses and the initiation of new field projects, our FY2003 operations and equipment budget is similar to FY2002.

Budget Summary

FY02 Admin Report Network: Cape Cod NS Prototype

Category: 1_Income

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
a) Authorization for FY2002	$702,000.00	Prototype Monitoring $$		
b) For CA with Univ. of Rhode Is. - estuarine benthos protocol	$70,000.00	USGS-BRD		
Subtotal	*$772,000.00*			

Category: 2_Personnel

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
a) Prototype Coordinator	$79,564.00	Prototype Monitoring $$	NPS	
b) Budget Assistant	$22,908.00	Prototype Monitoring $$	NPS	
c) Wildlife Ecologist	$77,755.00	Prototype Monitoring $$	NPS	
d) Plant Ecologist	$27,900.00	Prototype Monitoring $$	NPS	
e) Aquatic Ecologist (SCEP)	$36,442.00	Prototype Monitoring $$	NPS	
f) Physical Scientist	$5,541.00	Prototype Monitoring $$	NPS	
g) Wildlife BioTech	$33,157.00	Prototype Monitoring $$	NPS	
h) Laboratory Tech	$17,083.00	Prototype Monitoring $$	NPS	
i) Data Management Assistant (SCEP)	$2,150.00	Prototype Monitoring $$	NPS	
j) Seasonal BioTech - small mammal monitoring	$2,730.00	Prototype Monitoring $$	NPS	
k) Seasonal BioTech - amphibian & reptile monitoring	$11,391.00	Prototype Monitoring $$	NPS	
l) Seasonal BioTech - coastal forest monitoring	$13,536.00	Prototype Monitoring $$	NPS	
m) Seasonal BioTech - pond water quality monitoring	$12,098.00	Prototype Monitoring $$	NPS	
n) 4-Student Conservation Association Volunteers	$12,855.00	Prototype Monitoring $$	NPS	includes housing
Subtotal	*$355,110.00*			

Category: 3_Coop. Agreements

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
a) USGS-WRD - Ground-Water Quality Protocol	$60,000.00	Prototype Monitoring $$	USGS	
b) Univ. of Rhode Is. - Estuarine Benthos Protocol	$100,000.00	Prototype Monitoring $$	University-CESU	CA through CESU; $70,000 from USGS-BRD & $30,000 from CACO
c) Harvard Univ. - Freshwater Aquatic Invertebrate Protocol	$51,000.00	Prototype Monitoring $$	Univ_Non-CESU	

d) Univ. of Mass. - Avian Point Count Protocol	$39,970.00	Prototype Monitoring $$	Univ_Non-CESU	
e) Inst. for Bird Populations - MAPS Project	$27,000.00	Prototype Monitoring $$	Other non-Federal	
f) Univ. of Rhode Is. - Intertidal Mapping Project	$45,031.00	Prototype Monitoring $$	University-CESU	
g) Univ. of Mass. - Vegetation Map: Photointerpretation	$8,009.00	Prototype Monitoring $$	Univ_Non-CESU	
Subtotal	*$331,010.00*			

Category: 5_Operations/Equipment

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
a) Field Equipment & Supplies	$13,625.00	Prototype Monitoring $$	Other non-Federal	
b) Laboratory Equipment & Supplies	$32,348.00	Prototype Monitoring $$	Other non-Federal	
c) Computer Hardware, Software, Maintenance & Supplies	$11,911.00	Prototype Monitoring $$	Other non-Federal	
d) GPS Equipment	$2,398.00	Prototype Monitoring $$	Other non-Federal	
e) Office Supplies	$1,014.00	Prototype Monitoring $$	Other non-Federal	
f) Miscellaneous	$2,104.00	Prototype Monitoring $$	Other non-Federal	Includes references & printing
Subtotal	*$63,400.00*			

Category: 6_Travel

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
Travel and Training	$6,309.00	Prototype Monitoring $$	Other non-Federal	
Subtotal	*$6,309.00*			

Category: 7_Other

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
Vehicle	$16,171.00	Prototype Monitoring $$	Other non-Federal	
Subtotal	*$16,171.00*			

FY2002 Budget Analysis

Analysis of Expenses by Expense Type

Funding Source	Total $$	NPS	USGS	Other Federal	Univ.-CESU	Univ_Non-CESU	Other non-Federal
Prototype Monitoring $$	$772,000	$355,110	$60,000		$145,031	$98,979	$112,880
Totals	$772,000	$355,110	$60,000		$145,031	$98,979	$112,880

Analysis of Expenses by Category

Funding Source	Total $$	Personnel:	Coop Agree.	Contracts	Operations/Equip.	Travel	Other
Prototype Monitoring $$	$772,000	$355,110	$331,010		$63,400	$6,309	$16,171
Totals	$772,000	$355,110	$331,010		$63,400	$6,309	$16,171

Expense Totals By Category

Category	SubTotal	Percent
2_Personnel	$355,110	46.00%
3_Coop. Agreements	$331,010	42.88%
5_Operations/Equipment	$63,400	8.21%
6_Travel	$6,309	0.82%
7_Other	$16,171	2.09%
	$772,000	

Budget Summary

FY03 Work Plan Network: Cape Cod NS Prototype

Category: 1_Income

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
Anticipated Authorization for FY2003	$702,000.00	Prototype Monitoring $$		
Subtotal	*$702,000.00*			

Category: 2_Personnel

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
a) Prototype Coordinator	$87,668.00	Prototype Monitoring $$	NPS	
b) Data Manager	$35,268.00	Prototype Monitoring $$	NPS	
c) Budget Assistant	$25,886.00	Prototype Monitoring $$	NPS	
d) Wildlife Ecologist	$81,503.00	Prototype Monitoring $$	NPS	
e) Plant Ecologist	$68,806.00	Prototype Monitoring $$	NPS	
f) Aquatic Ecologist	$41,456.00	Prototype Monitoring $$	NPS	
g) Wildlife BioTech	$36,359.00	Prototype Monitoring $$	NPS	
h) Laboratory Tech	$17,783.00	Prototype Monitoring $$	NPS	
i) Aquatic Ecology BioTech	$25,649.00	Prototype Monitoring $$	NPS	
j) Hydrology Tech	$25,649.00	Prototype Monitoring $$	NPS	
k) Seasonal BioTech - coastal forest monitoring	$7,300.00	Prototype Monitoring $$	NPS	
l) Seasonal BioTech - salt marsh monitoring	$7,300.00	Prototype Monitoring $$	NPS	
m) Seasonal BioTech - estuarine nekton monitoring	$9,800.00	Prototype Monitoring $$	NPS	
n) Seasonal BioTech - amphibian & reptile monitoring	$14,600.00	Prototype Monitoring $$	NPS	
o) Seasonal BioTech - marsh & migratory waterbird monitoring	$14,600.00	Prototype Monitoring $$	NPS	
p) 7-Student Conservation Association or other volunteers	$35,500.00	Prototype Monitoring $$	Other non-Federal	
Subtotal	*$535,127.00*			

Category: 3_Coop. Agreements

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
New inventory or monitoring agreements	$45,000.00	Prototype Monitoring $$	University-CESU	
Potential augmentation of existing agreements	$35,000.00	Prototype Monitoring $$	University-CESU	
Subtotal	*$80,000.00*			

Category: 5_Operations/Equipment

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
a) Field Equipment & Supplies	$17,500.00	Prototype Monitoring $$	Other non-Federal	
b) Laboratory Equipment & Supplies	$27,500.00	Prototype Monitoring $$	Other non-Federal	
c) Computer Hardware, Software, Maintenance & Supplies	$10,000.00	Prototype Monitoring $$	Other non-Federal	
d) GPS Equipment	$3,000.00	Prototype Monitoring $$	Other non-Federal	
e) Office Supplies	$2,000.00	Prototype Monitoring $$	Other non-Federal	
f) Miscellaneous	$11,873.00	Prototype Monitoring $$	Other non-Federal	includes Symposium expenses, printing, and one PCS move
Subtotal	*$71,873.00*			

Category: 6_Travel

Description	*$ Amount*	*$$ Source*	*Expense Type*	*Comments*
Travel and Training	$15,000.00	Prototype Monitoring $$	Other non-Federal	
Subtotal	*$15,000.00*			

FY2003 Budget Analysis

Analysis of Expenses by Expense Type

Funding Source	Total $$	NPS	USGS	Other Federal	Univ.-CESU	Univ_Non-CESU	Other non-Federal
Prototype Monitoring $$	$702,000	$499,627			$80,000		$122,373
Totals	$702,000	$499,627			$80,000		$122,373

Analysis of Expenses by Category

Funding Source	Total $$	Personnel:	Coop Agree.	Contracts	Operations/Equip.	Travel	Other
Prototype Monitoring $$	$702,000	$535,127	$80,000		$71,873	$15,000	
Totals	$702,000	$535,127	$80,000		$71,873	$15,000	

Expense Totals By Category

Category	SubTotal	Percent
2_Personnel	$535,127	76.23%
3_Coop. Agreements	$80,000	11.40%
5_Operations/Equipment	$71,873	10.24%
6_Travel	$15,000	2.14%
	$702,000	

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